TYPESCRIPT @BING

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Agenda

Why we chose Type Script ?

- The sweet spot between Types and Idiomatic Javascript

Current adoption

- 15% current adoption.
- Target: 100%

Integration with Bing Resource Management System (RMS)

- Save and Refresh
- Build

Stint with AMD

- How we are trying to move to AMD with Typescript

JS2TS Magic

- Our solution for auto converting Javascript files to TypeScript files

Why we chose Type Script ?

We love writing idiomatic Javascript

- Module pattern
- Patterns like currying

We also realize the lack of tooling to help maintainability

- Lack of strongly typed contracts
- Lack of IDE support with intellisense, refactoring etc.

Typescript hits the sweet spot

- Compared to other technologies like Script#

Current Adoption

15% of our Javascript Codebase is in TypeScript

- It is growing at a very fast rate

25,000 lines of code so far in Type Script.

- Bing Mobile Experiences
- Bing Windows 8 App
- Friends Photos (Social)
- Parts of Search Results Page

Target is to hit 100% adoption

- JS2TS tool that Sarvesh will demo will help us adopt TypeScript at a scale.

Best Practices

http://bing/wiki/TypeScript

Favor modules over classes

- Most of Bing Web Page code is asynchronous, reactive and pub-sub based.
- Classes are verbose and at Bing, page weight is a significant concern.

Code to Interfaces

Integration with Bing RMS

- RMS manages both the compilation (crunching, bundling etc) and the rendering of Javascript files (inlined, referenced etc).
- We added support for TypeScript files into RMS
  - When a typescript file changes
    - RMS invokes TS compiler to compile the file along with its dependencies
    - The generated file is then run through a cruncher
    - And then is concatenated with other files if necessary.
  - We use Node JS to invoke TypeScript compiler (<Import Project="$(PackagesRoot)\TypeScript.NodeJs.Tools\TypeScript.NodeJs.AMD.targets" />)
- Batch compilation saves time by orders of magnitude.

Stint With AMD

```
[Js_AjaxHistory]
_meta.type=Microsoft.Search.Frontend.ResourceManagement.Configuration.IResourceConfig
ResourceKey=Ajax.History
RenderEndpoint=JsAfterOnLoad
ReferencingMethod=alwaysReference
FilePath&win8:app2=Scripts\Ajax\ajax.pushstate.js
FilePath=Scripts\Ajax\ajax.history.js
Dependencies=Shared.Event.Customs
```

Stint With AMD

- Ajax.History is the interface (d.ts)
- Ajax.PushState and Ajax.History are two possible implementations of the above interface
- Developers code to the d.ts
  - Import("Ajax.History");
  - AMD Loader will at runtime decide which implementation to load, based on its configuration.
- Challenges:
  - Modules and Interfaces are incompatible
  - Importing a d.ts file is not allowed.

JS2TS Demo

CloudMake – Automating Builds using Typescript

Tools for Software Engineers
Wolfram Schulte

http://tse & http://codebox/clouddev

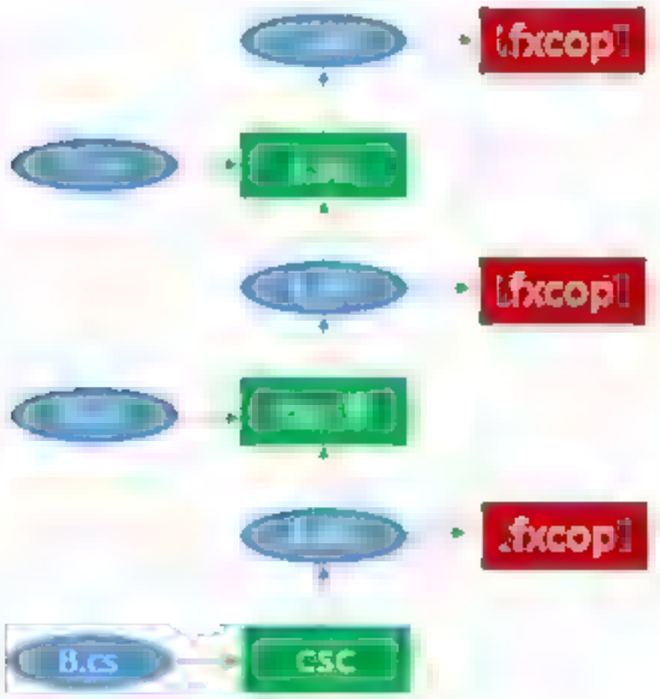
TypeScript Meetup 6/6/2013

Why do we need another language for builds, installers, tests, deployments?

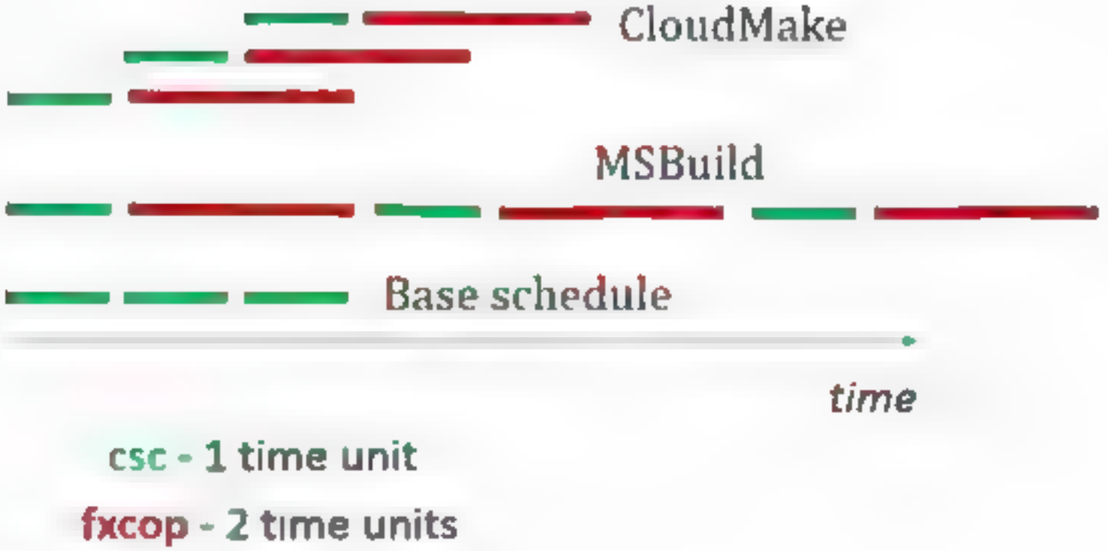
- Reliability
  - Comprehensibility, repeatability, precise dependency and constraint manageability
- Composability
  - Allow building abstractions: functions, modules, versions, visibility
- Speed
  - Response time proportional to size of change, never wait longer than longest critical path
- Resource efficiency
  - Reuse your earlier work or work done by others, scale-up and out, multi-tenancy

Finding the Right Level of Abstraction

Example: MSBuild after Target



Schedules



CloudMake

A language and runtime system for **describing and executing automated workflows**, like builds, installers, tests, or deployments.

CloudMake

- is designed to be **compatible with Typescript** as much as possible
- avoids features that are difficult to control
- is **easy to extend** with external tools
- **works without** a sophisticated programming **environment**
- is the language of choice for CloudDev!

CloudMake – Hello World

```
///<referencepath= '//Tools/StandardTools.cm'>

var main    =    csc ({sources:['helloworld.cs']});
```

Output Artifact *Tool/Function* *Input Artifact*

Multi-directory Builds

```
///<referencepath= 'Speller/Speller.cm'>

module Microsoft.Office.Word {

    export var EditingSurface = csc(
      {
        AssemblyName:"Microsoft.Office.Word.EditingSurface",
        OutputType: OutputType.Library,
        Sources: ['Canvas.cs', 'Renderer.cs','MessageLoop.cs'],
        References: [Microsoft.Office.Word.Speller.CoreSpeller.dll]
      });
}
```

Reference of other build artifact

Everything typed, no type annotation needed

Composability

```
module Microsoft.Office.Word.Speller {
    export var CoreSpeller = csc(
        {
            AssemblyName: "Microsoft.Office.Word.Speller",
            Sources: ['language.cs', 'grammar.cs'],
            …
        });

    export var En = BuildLanguage("En")
    export var Nl = BuildLanguage("Nl")
    …

    function BuildLanguage(languageCode) {
        return csc(
        {
            AssemblyName: "Microsoft.Office.Word.Speller.Languages." + languageCode,
            Sources: [Path.combine('.',languageCode +".cs")],
            References: [CoreSpeller.dll]
        });
    }
}
```

Defining Tools

```
interface CscArgs {
        AssemblyName? : String;
        Sources       : CsFile[];
        References?   : Assembly[];
        OutputType?   : OutputType;
}

function csc (args: CscArgs) : Assembly
{
        var output  =    Path.Combine('//output/', args.assemblyName, ".dll")
        var srcs    =    sources.map(s => s.cs)
        var refs    =    references.map(r => r.dll)

        var cmdargs =    ["/out:" + outputAssembly]
                         .add ("/target:" + ToTargetString(OutputType))
                         .addRange (refs.map( r => "/r:" + r))
                         .addRange (srcs)

         return {dll: exec({
                         tool                : '//clr/csc.exe'
                         arguments           : cmdargs,
                         dependencies        : srcs.AddRange(refs),
                         expectedResults     : [output] }) [0] }
}
```

CloudMake
- A Purely Functional Subset of TypeScript

Inherits Syntax, Type System and subset of semantics

- **Primitive types** and operations are the ***same***
- **Arrays and Objects** support ***only non-side effecting operations***
- **All variables** (except for function locals) are ***single assignment only***
- **No** support for ***classes, overloading***

Special support for

- **Paths**, written with **'...'** and, strings **"..."**
- **Variable initialization**, which is **lazy,** i.e. CM is more defined than TS

CloudMake – Implementation and Performance

Implemented as **direct interpreter in .NET**

- Parse tree used for evaluation, type tagged representation
- Two phase execution: (1) evaluates the prog to a schedule (2) run the schedule

Performance (exemplary)

Evaluating CM	**7X faster than compiling Typescript**
Sequential CM	1.0 – 1.2X faster than running Sequential MS Builds
Multicore CM	1.1 – 2X faster than running Multicore MS Builds
Incremental CM	1.1 to 25X faster than running Incremental MS Builds
Distributed CM	Worst case execution time is duration of critical path

CloudMake - Next steps

- Work with TypeScript team on language features and tool optimizations
- Add support for **multi-flavored and multi-versioned builds**
- Synthesizing CloudMake **programs from traces**
- Create **simple exe** so that **you can use it**
- Get **your feedback**, and improve!

Overview

- Decorators
- Iterators and for..of
- Generators
- Async/Await

Example: TypeUnit

```
import Promise = module('promise');
import TypeUnit = module('typeunit');
var test = TypeUnit.test,
    timeout = TypeUnit.timeout,
    data = TypeUnit.data;

export class PromiseFixture {
  @test
  @timeout(100)
  computeAsync(): void {
    …
    p.then(
      @stage function(v) { TypeUnit.Assert.equal(1, v); },
      @stage function(e) { TypeUnit.Assert.fail(e); });
  }

  static parseData(): any[][] { … }

  @test
  @data(PromiseFixture.parseData)
  parse(url, match): void { … }
}
```

- `@test` decorator to mark test methods
- `@timeout` decorator marks maximum duration for test
- `@data` decorator performs data-bound tests
- `@stage` decorator wraps a callback in the test framework so that failed assertions are caught
- TypeUnit is available at http://codebox/typeunit

Example: Ember.js to TypeScript (with Decorators)

ES5

```
App.Person = DS.Model.extend({
  firstName: DS.attr('string'),
  lastName: DS.attr('string'),
  birthday: DS.attr('date'),
  fullName: function() {
    return this.get('firstName') +
           ' ' +
          this.get('lastName');
  }.property('firstName', 'lastName')
});
```

TypeScript

```
class Person extends DS.Model {
  // replaces firstName with a get/set accessor
  @attr('string')
  firstName: string;

  @attr('string')
  lastName: string;

  @attr('date')
  birthday: Date;

  @property('firstName', 'lastName')
  get fullName() {
    return this.firstName +
           ' ' +
          this.lastName;
  }
});
```

Example: TypeUnit

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Iterators

```
/// <reference path="generators.ts" />
function* filter(
  iter: Iterator,
  predicate: (value: any) => bool): Iterator {

  for(var value of iter) {
    if (predicate(value)) {
      yield value;
    }
  }
}

var a = [1, 2, 3];
var f = filter(a, v => v % 2);
for(var v of f) {
  console.log(v); // LOG: 1
                  // LOG: 3
}

// class examples
class Map {
  *keys(): Iterator { … }
  *values(): Iterator { … }
  __iterator__(): Iterator { … }
}
```

- `function*` signals rewrite of function body
- `for…of` is rewritten to call `__iterator__` and repeatedly execute calls to `next`
- Using Iterators/generators requires a reference to or an import of the 'generators' module defined in generators.ts

Generators

(based on TS 0.8.3 and ES6 spec prior to May, 2013)

```
/// <reference path="generators.ts" />
function* backAndForth() {
  var b = yield 3;
  console.log("b = %s", b);

  var d = yield b + 1;
  console.log("d = %s", d);
  return d - 1;
}

var o = backAndForth();
try {
  var a = o.next();
  console.log("a = %s", a);

  var c = o.send(a + 2);
  console.log("c = %s", c);

  o.send(c * 2);
}
catch (ex) {
  if (!isStopIteration(ex)) { throw e; }
  var e = ex.value;
  console.log("e = %s", e);
}
```

- Output:
  ```
  LOG: a = 3
  LOG: b = 5
  LOG: c = 6
  LOG: d = 12
  LOG: e = 11
  ```
- `function*` signals rewrite of function body, allowing `yield` to be interpreted as a keyword and not an identifier.
- The ES6 `yield` keyword is an expression, allowing callers to send values back into the generator as the result of the expression.
- The `return` statement in a generator throws `StopIteration` with an optional value.
- Using Iterators/generators requires an reference to or an import of the 'generators' module defined in generators.ts

Async/Await

```
/// <reference path "generators.ts" />
import futures = module('futures');
import httpclient = module('httpclient');

async function getJSONAsync(url: string): futures.Future<any> {
  var client = new httpclient.HttpClient();
  var response = await client.getAsync(url);
  return JSON.parse(response.responseText);
}

async function fetchAuthProviders(vm: AuthViewModel): void {
  var providers = await getJSONAsync(authProviderUrl);
  vm.providers(providers);
}
```

- `async` keyword signals rewrite of function body
- Return type annotation must be a `Thenable` or `void`
- `void` return type annotation signals that any errors are thrown to the browser/engine
- `await` keyword halts execution until the thenable produces a value or a result.
- `await` auto-lifts non-thenable values
- Using async/await requires an import of the 'generators' module defined in generators.ts

Notes

Current Version

- Based on TS 0.8.3
- Supports:
  - Decorators (functions, classes; class methods, getters, setters)
  - Iterators (pre-May, 2013)
  - Generators (pre-May, 2013)
  - Async/Await
  - VS Editor
- Not Supported:
  - Decorators (fields)
- Fork available here

New Version

- Based on TS 0.9.0
- Supports:
  - Decorators (functions; classes; class methods, getters, and setters)
- Coming Soon:
  - Decorators (fields; object literal methods, getters, and setters; better type-safety)
  - Iterators (post-May, 2013)
  - Generators (post-May, 2013)
  - Async/Await
  - VS Editor
- Long-term:
  - Array/Object destructuring
  - Generator/Array comprehensions
- Fork Available here

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Async/Await Definitions

```
interface Thenable {
  then(resolve: Function, reject?: Function): any;
}

interface Awaiter {
  awaiter: Thenable;
}

interface Deferred {
  resolve(value: any): void;
  reject(value: any): void;
  promise: Thenable;
}

declare var Awaiter: {
  defer(): Deferred;
}
```

- Defined in 'generators' module
- General interface designed to match Promise/A-style promises/futures.
- Uses a built-in general purpose Promise/A-like object internally.
- Developers can replace built-in behavior by overriding the `Awaiter.defer` method with a compatible API (or wrapper).

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